

In response to the Official Action dated August 8, 2001, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please amend the specification as follows:

Please substitute the paragraph beginning at page 2, line 4 with the following. A marked-up copy of this paragraph, showing the changes made thereto, is attached in Appendix A.

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Q1 -- From Rayleigh's formula, when the numerical aperture is increased to increase the resolving power, the DOF is reduced. Therefore, the numerical aperture of an exposure apparatus is determined to be a maximum value from the specifications of the apparatus. However, when exposure apparatuses are actually used, they are ordinarily used under exposure conditions optimum to the line width, that is, with an optimum numerical aperture under optimum illumination conditions. For this purpose, a numerical aperture variable mechanism is assembled for the projection optical system of the exposure apparatus so as to set a numerical aperture value according to a line width to be processed. --

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Please substitute the paragraph beginning at page 2, line 17 with the following. A marked-up copy of this paragraph, showing the changes made thereto, is attached in Appendix A.

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Q2 -- Incidentally, the projection optical system is required to have stabilized performances as one of its requirements. Particularly, the projection optical system is required to have stability with respect to its environment and stability with respect to thermal aberration,

which is caused by heat absorbed by the glass material of the projection optical system during exposure, and the like. --

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Please substitute the paragraph beginning at page 2, line 25, and ending on page 3, line 10, with the following. A marked-up copy of this paragraph, showing the changes made thereto, is attached in Appendix A.

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93 -- Conventionally, a method of using a glass material excellent in permeability, a method of restricting the amount of heat absorbed by the projection optical system, and the like, are employed to suppress the influence of the thermal aberration. However, it was found by the inventors that when the projection optical system was used with various kinds of numerical apertures, a heat source, where a maximum amount of heat was generated, was the portion of the diaphragm of the numerical aperture variable mechanism provided with the pupil unit of the projection optical system. --

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Please substitute the paragraph beginning at page 3, line 22, and ending on page 4, line 17, with the following. A marked-up copy of this paragraph, showing the changes made thereto, is attached in Appendix A.

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94 -- However, the situation is entirely changed when a reticle (mask) having a pattern is inserted into the path of the exposure light beam. This is because scattered light (diffracted light) from a pattern of the reticle exists in a light beam having passed through the reticle and the scattered light is irradiated to the diaphragm, while direct light from the projection optical system

corresponds to the primary light beam passing through the reticle. Further, the diaphragm is usually composed of a metallic material, or the like, and ordinarily absorbs an exposure beam to a large extent. This is problematic, since even the heat absorbed by the glass material of the projection optical system, which has a large permeability and absorbs an exposure beam only to a slight extent, causes a problem. Therefore, the heat resulting from the beam being absorbed by the diaphragm causes a large problem. When the diaphragm is heated by the exposure beam absorbed thereby, the air in the vicinity of the diaphragm is also heated by the heat of the diaphragm. As a result, the glass material is indirectly heated and a Schlieren effect is produced by the convection of the air, whereby the projection optical system is made unstable. --

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Please substitute the paragraph beginning at page 8, line 7, and ending on page 9, line 4, with the following. A marked-up copy of this paragraph, showing the changes made thereto, is attached in Appendix A.

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95 -- In the numerical aperture switching unit 8, a numerical aperture diaphragm has an opening that is opened in a shape corresponding to the effective diameter of the projection optical system. A numerical aperture value, in which the projection optical system 2 is operated, is determined by a pattern to be exposed, and a command is issued to the numerical aperture switching unit 8 from a controller (not shown) of the exposure apparatus. The numerical aperture switching unit 8 is composed of metal and acts as a body for absorbing an exposure beam. When no pattern is formed on the reticle 1, no light beam is irradiated to the portion of the diaphragm provided with the pupil unit of the projection optical system 2. However, when a

pattern is formed on the reticle 1, a light beam is scattered thereon and a portion of the scattered light beam directly impinges on the above-noted portion of the diaphragm. For example, when the pattern is a repeated pattern having a duty of 1 : 1, the ratio of an intensity of a primary light beam and a secondary light beam is 1 : 0.41. Therefore, it can be determined that when a primary light beam of an oblique incident light beam impinges on the numerical aperture diaphragm, a light beam having a considerable amount of intensity impinges on the diaphragm. --

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Please substitute the paragraph beginning at page 11, line 13, and ending on page 12, line 4, with the following. A marked-up copy of this paragraph, showing the changes made thereto, is attached in Appendix A.

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ab -- FIG. 2 is a plan view and a section view of the iris diaphragm acting as the numerical aperture switching unit 8. In FIG. 2, reference numeral 9 denotes the iris diaphragm arranged such that the numerical aperture is adjusted by a plurality of blades. A temperature adjusting medium such as water flows through a liquid passage 11, which is disposed in the interior of the circular frame 10 of the iris diaphragm 9. The object of the present invention can be achieved by separating a diaphragm diameter variable mechanism from a temperature control device and disposing them so that they are in contact with each other. Further, in FIG. 2, since the liquid passage into which the temperature adjusting medium flows is disposed in confrontation with the liquid passage from which the temperature adjusting water flows out, the temperature is made uniform, and distortion of the iris diaphragm 9 is prevented. --

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Please substitute the paragraph beginning at page 14, line 15 with the following. A marked-up copy of this paragraph, showing the changes made thereto, is attached in Appendix A.

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97 -- In the third embodiment of the present invention, shown in FIG. 5, a Peltier element 13 is used as the cooling means for a diaphragm 12. The Peltier element 13 is bonded to the diaphragm 12 at the wafer side thereof and a thermocouple 14, which is the temperature measuring means of the diaphragm 12, is also bonded to the diaphragm 12 at the wafer side thereof, similarly. An electromotive force of the thermocouple 14 is supplied to a measuring instrument 15 and the Peltier element 13 is operated through a controller 16. --

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Please substitute the paragraph beginning at page 16, line 22, and ending on page 17, line 18, with the following. A marked-up copy of this paragraph, showing the changes made thereto, is attached in Appendix A.

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98 -- FIG. 7 is a flowchart showing the detailed steps of the wafer process discussed above with respect to step 4 in FIG. 6. At step 11 (oxidation), the surface of the wafer is oxidized. At step 12 (chemical vapor deposition - CVD), an insulating film is formed on the surface of the wafer. At step 13 (the forming of an electrode), an electrode is formed on the wafer by vapor deposition. At step 14 (ion implantation), ions are implanted into the wafer. At step 15 (resist processing), a photo-resist is applied to the wafer. At step 16 (exposure), the circuit pattern of the mask is printed and exposed onto the wafer by the exposure apparatus. At step 17 (development), the exposed wafer is developed. At step 18 (etching), the portions other than the developed resist image are removed. At step 19 (the peeling-off of the resist), the resist,